

CONSTRUCTED WETLAND

(No.)
Code 656

Natural Resources Conservation Service
Conservation Practice Standard

I. Definition

A constructed shallow water ecosystem designed to simulate natural wetlands.

II. Purpose

To reduce the pollution potential of runoff and wastewater from agricultural lands to water resources

III. Conditions Where Practice Applies

- Where a constructed wetland is a component of a planned conservation system or agricultural waste management system.
- Where wastewater or runoff originates from agricultural lands including livestock or aquaculture facilities.
- Where a constructed wetland can be constructed, operated and maintained without polluting air or water resources.

This practice does not apply to WI FOTG Standard 657, Wetland Restoration; Standard 658, Wetland Creation; or Standard 659, Wetland Enhancement.

IV. Federal, State, and Local Laws

Users of this standard should be aware of potentially applicable federal, state and local laws, rules, regulations or permit requirements governing constructed wetlands. This standard does not contain the text of federal, state, or local laws.

V. Criteria

A. General Criteria Applicable To All Purposes

1. Location

Constructed wetlands shall be located outside the limits of wetlands of any classification.

Constructed wetlands located within a floodplain shall be protected from

inundation or damage from a 25-year flood event, or larger, if required by laws, rules, and regulations.

Constructed wetlands shall be located to provide sufficient separation distances from structures such as residences and commercial buildings so prevailing winds and landscape elements such as building arrangement, landforms, and vegetation will minimize odors and protect aesthetic values. They shall be located with a separation distance of 100 feet to any well.

The bottom of the planned root zone for the constructed wetland shall be 2 feet above *bedrock*¹ or the *regional high water table*.

2. Type

Constructed wetlands shall be designed as surface flow systems consisting of adequate seepage control, a suitable plant medium, rooted emergent hydrophytic vegetation, and the structural components needed to contain and control the flow.

3. Influent

The influent to the constructed wetland shall be pretreated to reduce the concentrations of solids, organics, and nutrients to levels that will be tolerated by the wetland system and not cause excessive accretion within the wetland.

Where significant sediment and organic debris are expected in the wastewater or runoff to be treated, provisions for its entrapment before entry into the wetland must be provided.

A wetland that will receive influent from wastewater and runoff sources shall meet the criteria for both purposes.

4. Water Budget

A water budget that evaluates runoff or wastewater volumes, precipitation, evaporation, and water use shall be used to determine the required hydraulic retention time in the wetland and storage requirements of the wetland pretreatment and post treatment facilities when included.

5. Embankment

The perimeter embankment shall have a minimum top width of 10 feet. Interior embankments shall have a minimum top width of 8 feet. If site conditions or owner preference result in a narrower top width, the Operation and Maintenance plan must reflect the additional effort required for vegetation maintenance and embankment repair. All embankment side slopes shall be a minimum of a 2 horizontal to 1 vertical.

6. Vegetation

Vegetation selected for the constructed wetland shall be hydrophytic plants suitable for local climatic conditions and tolerant of the concentrations of nutrients, pesticides, and other constituents in the runoff or wastewater stream and selected for their treatment potential.

Preference shall be given to native wetland plants with localized genetic material. Plant materials collected or grown from material collected within the same Major Land Resource Area (MLRA) are considered local.

7. Planting Medium

The soil used for the planting medium shall have a cation exchange capacity, pH, electrical conductivity, soil organic matter, and textural class that is conducive to wetland plant growth and retention of contaminants.

8. Seepage Control

The constructed wetland shall be located in soils with an acceptable permeability that meets all applicable regulations, or it shall be lined. Measures for controlling seepage with a soil liner shall be designed according

to the procedures of NRCS NEH Part 651, Agricultural Waste Management Field Handbook, Appendix 10d, "Geotechnical Design and Construction Guidelines."

The use of bentonite to reduce wetland soil permeability shall be in conformance with WI FOTG Section IV Standard 521C, Pond Sealing and Lining, Bentonite Treatment.

A flexible membrane liner conforming to WI FOTG Section IV Standard 521A, Pond Sealing and Lining, Flexible Membrane Lining, may be used in place of a soil liner.

Livestock shall be excluded from the wetland.

B. Additional Criteria For Wetlands Constructed For Wastewater Treatment

1. Topography

Site topography shall accommodate the requirements for length to width ratios of the wetland and the wetland cells, and the requirement that the wetland cells be level side to side with grades of less than 0.05 ft/ft lengthwise.

2. Inlet

An inlet structure that will allow control of flow discharged to the wetland and screening of influent to prevent debris from entering the wetland shall be provided. Design of the inlet structure shall assure its function throughout the life of the wetland considering accretion.

3. Influent

Constructed wetlands for wastewater treatment shall not allow for direct inclusion of contaminated and/or uncontaminated runoff.

Wastewater will be of sufficient volume and duration to keep the constructed wetland moist at all times or accommodations shall be made for the addition of supplemental water.

Wastewater shall flow through a pretreatment tank or basin as needed to settle solids, mix or dilute wastewater, and regulate flow to the wetland.

4. Surface Area

The surface area of the wetland shall be determined using NRCS NEH Part 637, Environmental Engineering, Chapter 3, Constructed Wetlands. Influent concentration and volume, operating temperatures, the desired level of treatment, and the planned disposition of the effluent shall be factored into the design.

5. Configuration

The constructed wetland shall have an overall length to width ratio of 1:1 to 4:1. Individual cells within the constructed wetland shall have a length-to-width ratio of 10:1 to 15:1. The wetland shall consist of at least two rows of parallel cells.

Inlet and outlet plumbing shall be configured to allow any of the parallel cells to continue to operate if all others are shut down for repairs, resting, replanting, etc.

6. Flow Depth

The design depth shall be based on the most severe season of operation, the desired level of treatment, and the required littoral zone of the plant species being used. The design depth shall be a minimum of 0.33 ft. and a maximum of 1.5 ft.

7. Embankments

Height of the constructed wetland perimeter embankment shall be the sum of the following:

- Design depth
- Wetland accretion -- a minimum of 1 inch per year for the design life
- 25-year, 24-hour precipitation
- 12 inches of freeboard

The height of wetland's interior embankments shall be the minimum of the sum of the following:

- Normal design flow depth
- Wetland accretion -- minimum of 1 inch per year for the design life

8. Overflow Device

An ungated overflow device shall be provided to operate when the 25-year, 24-hour precipitation is exceeded. The overflow device shall operate without infringing on the wetland perimeter embankment's freeboard.

9. Outlet

Constructed wetlands will discharge to storage facilities designed in conformance with WI FOTG Standard 313, Waste Storage Facility, to allow for land application or the effluent shall be recycled through the waste management system.

Constructed wetlands for waste treatment shall not be designed to discharge to waters of the state unless permitted by state laws and regulations, and applicable permits have been obtained to do so. In addition, if discharge is permitted, the receiving surface water must have the capacity to assimilate the constructed wetland's effluent during low flow periods.

An outlet structure shall be provided that allows maintenance of proper water level in the wetland and controls the flow from the wetland.

C. Additional Criteria For Wetlands Constructed For Runoff Treatment

1. Design Storm

The constructed wetland system shall be designed to contain a 2-year, 24-hour storm runoff above any permanent pool depth. Limited area sites handling only the "first flush" volume shall have a minimum capacity to store 0.5 inch of runoff volume from the entire drainage area.

When less than full runoff is stored, bypass of the excess storm flow shall be provided. All bypassed flow and runoff in excess of the 2-year, 24-hour storm and up to the 25-year, 24-hour storm shall be handled in other treatment or storage facilities designed in accordance with applicable NRCS standards.

2. Detention Time and Surface Area

The detention time and surface area shall be calculated on the time required to achieve the required level of treatment based on the limiting contaminant present using NRCS NEH Part 637, Environmental Engineering, Chapter 3, Constructed Wetlands.

3. Wetland Cells

Length-to-width ratios are to be 4:1 to 10:1. Other dimensions and shapes that provide a more natural landscape appearance that meet treatment requirements can be used.

Refer to the NRCS NEH Part 650, Engineering Field Handbook, Chapters 13, "Wetland Restoration, Enhancement, and Creation," and 6, "Structures," for design information. Existing drainage systems will be utilized, removed, or modified as needed to achieve the intended purpose.

4. Depth

Maximum water depth shall be 24 inches except in those instances where deep water areas up to 4 feet are included as a special design feature. The deepened section shall total no more than 10 percent of the surface area of the wetland cell.

5. Outlet

A water control structure to automatically regulate storage release in accordance with the design detention time shall be installed. The outlet shall direct effluent to a land application area, a wastewater treatment strip, WI FOTG Standard 635, or a waste storage facility, WI FOTG Standard 313, as applicable based on the content of the effluent.

VI. Considerations

Additional recommendations relating to design that may enhance the use of, or avoid problems with, this practice but are not required to ensure its basic conservation functions are as follows.

- A. Locate constructed wetlands downgrade and as near the source of wastewater as practical.

- B. Install measures to exclude or minimize attractiveness of the constructed wetland to wildlife that could be adversely affected by the constructed wetland. Take measures to exclude burrowing animals should they frequent the wetland. Consider the use of fences as an exclusion measure.
- C. Recycle constructed wetland effluent back through the agricultural waste management system when practical.
- D. Consideration should be given to storage of wastewater during winter months instead of wetland operation.
- E. Add additional height to embankments to accommodate accumulated ice when constructed wetlands are used in cold climates.

VII. Plans and Specifications

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use. Plans shall include construction sequence, vegetation establishment, and management and maintenance requirements.

VIII. Operation and Maintenance

An operation and maintenance plan shall be developed that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design. Operational requirements should include:

- Maintenance of water level in wetland cells appropriate for vegetation
- Control flow to wetland according to water budget
- Monitoring of wetland performance
- Sampling effluent for nutrients prior to utilization.
- Surveillance of inlet and outlet

Maintenance requirements should include:

- Repair of embankments
- Control of vegetation
- Repair of fences or other ancillary features
- Replacement of wetland plants
- Repair of pipelines
- Control of unwanted animals (varmints) or vectors (mosquitoes)

IX. References

USDA, NRCS National Engineering Handbook, Part 651, Agricultural Waste Management Field Handbook.

USDA, NRCS National Engineering Handbook, Part 650, Engineering Field Handbook.

USDA, NRCS Wisconsin Field Office Technical Guide (FOTG), Section IV, Practice Standards and Specifications.

USDA, NRCS National Engineering Handbook, Part 637, Environmental Engineering.

X. Definitions

Bedrock (V.A.1.) – Consolidated rock material and weathered in-place material with > 50%, by volume, larger than 2 mm in size.

Regional High Water Table (V.A.1.) – The seasonal high free water surface of a large body of groundwater covering a region. All soil below the regional water table is saturated. Soil mottling (redoximorphic features) is not necessarily an indicator of the regional high water table, but is an indication of soil saturation.